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COMPLETE SPECIFICATION

Silver Base Non-Welding Electrical Contacts and Methods of Making the same

We, IGRANIC ELECTRIC COMPANY LIMITED, a British Company, of Elstow Road, Bedford, in the county of Bedford (assignees of LINWOOD THOMAS RICHARDSON, citizen of the United States of America, of Wanwatosa, County of Milwaukee, State of Wisconsin, United States of America), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to molded and heat sintered silver base non-welding electrical contacts and methods of making the same.

Molded and heat sintered electrical contacts as heretofore produced inherently have an undesirable relatively high contact resistance when initially put into use. However, the contact resistance of such contacts is lowered to an unobjectionable value after the contacts have been in operation for some time.

It has heretofore been proposed to coat such non-welding contacts with a protective layer of silver of such thickness as to remain a permanent part thereof, to counteract the natural and gradual increase in contact resistance thereof during a long period of use. On the other hand, such gradual increase in the contact resistance of the contacts during continued use thereof is in nowise as objectionable as the aforementioned high initial contact resistance.

The primary object of the invention is to provide an electrical contact of the aforementioned character of relatively inexpensive form in which the initial contact resistance thereof is minimized.

In accordance with our invention the surface of such a contact is modified by chemically applying thereto an extremely thin coating of silver. We prefer that such coating of silver shall not exceed one-thousandth of an inch in thickness; inasmuch as a coating of such character is adapted to insure the desired relatively low contact resistance, but is entirely eliminated from the co-operating face thereof after a very small number of circuit interrupting operations. By reason of this extremely thin applied coating of silver, sticking or welding of a pair of co-operating contacts of this character is insured against initially; whereas after a sufficient number of circuit making and breaking operations to effect removal of the silver coating the non-sticking or non-welding characteristics of the contact composition *per se* become effective.

We will herein specifically describe a silver molybdenum contact embodying our invention; but it is to be understood that the invention is likewise applicable to silver tungsten and other silver base non-welding, molded and heat sintered powder composition contacts the initial contact resistance of which it is desired to reduce or minimize.

When contacts molded from mixtures of silver and molybdenum powders are employed, we prefer that the same be composed of from thirty to seventy parts by weight of molybdenum and from seventy to thirty parts by weight of silver. On the other hand, contacts molded from mixtures of silver and tungsten powders are preferably composed of from fifty to seventy parts by weight of tungsten and from fifty to thirty parts by weight of silver.

As is well understood, a silver molybdenum contact consists of a mixture of predetermined proportions of the two dissimilar metals, silver and molybdenum, in powder form; the particles of said mixture of powders having been placed in intimate contact by molding thereof under pressure to the desired form. We have found that the

[*Price* 2/-]

Price 5s. 0d.

surface of such an article can be chemically coated or plated with silver, by simple immersion. After so coating the article the same is subjected to the usual heat sintering operation. As will be readily understood by those skilled in this art, a contact having a coating of not more than one-thousandth of an inch in thickness applied thereto in accordance with our invention will have such coating substantially reduced in thickness as an incident to the aforementioned heat sintering operation.

This phenomenon of coating by simple immersion is due to the fact that the metal molybdenum, if placed in a solution of silver nitrate, for example, will go into the silver nitrate solution and metallic silver will precipitate from the latter. That is to say, the molybdenum is more electropositive than the silver in a silver nitrate solution. When a silver molybdenum contact is immersed in such a solution, portions of the exposed particles of molybdenum will go into the solution and a proportional amount of silver will be deposited upon the silver particles at the surface of the contact.

We have found that dilute alkaline solutions of silver afford the best results. The silver salts employed may, for example, be silver cyanide, silver chloride or silver phosphate; but it is to be understood that other silver salts might be employed. The alkali may be ammonia, sodium hydroxide (caustic soda), or organic amines.

The following are examples of solutions which we have found satisfactory; the proportions by weight of the ingredients being given:—

Example A—silver cyanide, 2 parts; ammonia, 20 parts; and water, 100 parts.

Example B—silver chloride, 2 parts; sodium thiosulphate, 2 parts; sodium hydroxide, 1 part; and water, 100 parts.

Example C—silver chloride, 2 parts; sodium cyanide, 2 parts; ammonia, 20 parts; and water, 100 parts.

Example D—silver chloride, 2 parts; sodium thiosulphate, 2 parts; ammonia, 20 parts; and water, 100 parts.

In carrying out our invention we prefer to calculate the amount of silver to be used in the solution in accordance with the number and surface areas of the contacts to be coated or plated and the thickness of the coating desired thereon.

We prefer to place the silver solution in a suitable container; as, for instance, a barrel or cylinder mounted for rotation upon a suitable axis other than a vertical axis. The contacts are immersed in the solution and the container is rotated until deposition of the silver in the solution upon the contacts is completed; as determined by measurement, or by the lapse of a predetermined period of time.

In practice we have obtained the best results by employment of the silver salt solution set forth in Example A.

We have also found that the silver salt solution set forth in Example A is particularly well adapted to provide a suitable thin coating of silver upon molded contacts composed of suitable proportions of powdered silver and powdered cadmium; by immersion of the contacts in said solution and rotation of the container therefor in the manner aforedescribed.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A pressure molded and heat sintered electrical contact composed of silver and another material adapted to render the same non-welding when in use, said contact having a coating of silver of not more than approximately one-thousandth of an inch thickness deposited thereon by simple immersion thereof in a silver salt solution of such character that said other material is more electropositive than the silver in said solution, said silver coating being adapted to reduce the initial contact resistance of said contact.

2. A pressure molded and heat sintered electrical contact composed of silver powder and another material in powder form adapted to render the same non-welding when in use with another contact of similar composition, said contact having a coating of silver of not more than approximately one-thousandth of an inch thickness applied thereto by simple immersion thereof in a silver salt solution of such character that said other material is more electropositive than the silver in said solution, whereby portions of said other material go into the solution with consequent precipitation of corresponding portions of silver onto the surface of said contact, said silver coating acting to reduce the contact resistance of said contact during initial operation thereof.

3. A pressure molded and heat sintered electrical contact composed of silver and molybdenum, said contact having a coating of silver not more than approximately one-thousandth of an inch thick chemically applied thereto to minimize the initial contact resistance thereof when the same is put into use.

4. A pressure molded and heat sintered electrical contact composed of silver and molybdenum, said contact having a coat-

ing of silver not more than approximately one-thousandth of an inch thick deposited thereon by simple immersion thereof in a silver salt solution of such character that the molybdenum is more electropositive than the silver in said solution, said coating acting to reduce the initial contact resistance.

5. A non-welding, pressure molded and heat sintered electrical contact composed of silver and molybdenum in predetermined proportions, said contact having its surface modified by a coating of silver not more than approximately one-thousandth of an inch thick applied thereto by simple immersion thereof in a dilute alkaline solution of a silver salt of such character that the molybdenum is more electropositive than the silver of said solution, said coating acting to reduce the initial contact resistance.

6. A non-welding, pressure molded and heat sintered electrical contact composed of silver and molybdenum in predetermined proportions, said contact having its surface modified by a coating of silver of not more than approximately one-thousandth of an inch thickness applied thereto by simple immersion thereof in a dilute alkaline solution of a silver salt, the silver salt being of the group comprising silver cyanide, silver chloride, or silver phosphate, and the alkali being of the group comprising ammonia, caustic soda, or organic amines, whereby the molybdenum of said contact is rendered more electropositive than the silver of said solution, said coating acting to reduce the initial contact resistance.

7. A non-welding, pressure molded and heat sintered electrical contact composed of silver and molybdenum in predetermined proportions, said contact having its surface modified by a coating of silver of not more than approximately one-thousandth of an inch thickness applied thereto by simple immersion thereof in a solution comprising two parts by weight of silver cyanide, twenty parts by weight of ammonia, and one hundred parts by weight of water, said coating serving to substantially reduce the initial contact resistance of said contact when put into use, and said coating being characterized by dissipation thereof after a relatively small number of circuit controlling operations of the contact.

8. The method of reducing the initial contact resistance of a molded and heat sintered electrical contact composed of a mixture of powdered silver and another powdered material adapted to render the same non-welding when in use, which consists in immersing the contact in a silver salt solution of such character that said other material is more electropositive than the silver of the solution, whereby a portion of said other material goes into the solution and a substantially corresponding portion of the silver in the latter is deposited upon and attached to the surface of said contact, the silver so deposited comprising a coating of not more than approximately one-thousandth of an inch thickness.

9. The method of reducing the initial contact resistance of a pressure molded and heat sintered electrical contact composed of a mixture of powdered silver and another powdered material adapted to render the same non-welding when in use, which consists in immersing the contact in a silver salt solution of such character that said other material is more electropositive than the silver of the solution, whereby a portion of said other material goes into the solution and a substantially corresponding portion of the silver in the latter is deposited upon and attached to the surface of said contact, said contact and said solution being subjected to movement relatively to each other for a predetermined period of time to effect deposition of a silver coating of the desired thickness upon the contact, the thickness of the coating being not more than approximately one-thousandth of an inch.

10. The method of reducing the initial contact resistance of a pressure molded non-welding electrical contact composed of a mixture of silver powder and molybdenum powder in predetermined proportions, which consists in immersing said contact in a silver salt solution of such character that the molybdenum of the contact is more electropositive than the silver of the solution, whereby a portion of the molybdenum goes into the solution and a corresponding portion of the silver in the latter is deposited upon and attached to the surface of said contact, and thereafter subjecting the silver coated contact to the usual heat sintering operation, the thickness of the coating being not more than approximately one-thousandth of an inch.

11. The method of reducing the initial contact resistance of a pressure molded and heat sintered non-welding electrical contact composed of a mixture of silver powder and molybdenum powder in predetermined proportions, which consists in immersing the molded contact in a silver salt solution of such character that the molybdenum of the contact is more electropositive than the silver of the solution, whereby a portion of the molybdenum goes into the solution and a

corresponding portion of the silver in the latter is deposited upon and attached to the surface of said contact, said contact and said solution being subjected to rotary movement relatively to each other for a predetermined period of time to effect deposition of a silver coating of the desired thickness upon the contact, and subjecting the silver coated contact to a sintering temperature, the thickness of the coating being not more than approximately one-thousandth of an inch.

12. The method of reducing the initial contact resistance of a pressure molded and heat sintered non-welding electrical contact composed of a mixture of silver powder and molybdenum powder in predetermined proportions, which consists in immersing said contact, prior to heat sintering thereof, in a silver salt solution of such character that the molybdenum of the contact is more electropositive than the silver of the solution, whereby a portion of the molybdenum goes into the solution and a corresponding portion of the silver in the latter is deposited upon and attached to the surface of said contact, said contact and said solution being subjected to rotary movement relatively to each other for a predetermined period of time to effect deposition of a silver coating of not more than approximately one-thousandth of an inch thickness upon the contact, said silver coating being characterised by dissipation thereof at the contacting surface of the contact after a relatively small number of operations of the latter when in use.

13. The method of minimizing the initial contact resistance of a pressure molded and heat sintered non-welding electrical contact composed of a mixture of silver powder and molybdenum powder in predetermined proportions, which comprises immersing said contact, prior to heat sintering thereof, in a silver salt solution composed of about two parts by weight of silver cyanide, twenty parts by weight of ammonia, and one hundred parts by weight of water, whereby the molybdenum of the contact is more electropositive than the silver of the solution so that a portion of the molybdenum goes into the solution and a corresponding portion of the silver in the latter is deposited upon and attached to the surface of said contact, said contact and said solution being subjected to rotary movement relatively to each other for a predetermined period of time to effect deposition of a silver coating of not more than approximately one-thousandth of an inch thickness upon the contact, said silver coating being characterized by dissipation thereof at the contacting surface of the contact after a relatively small number of circuit controlling operations of the latter.

14. An electrical contact substantially as herein described.

Dated this 16th day of August, 1946.
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